

LIFE HISTORY OBSERVATIONS ON THE GRASSHOPPER
APPALACHIA HEBARDI REHN AND REHN
(ORTHOPTERA: ACRIDIDAE: MELANOPLINAE)

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Abstract.—The brachypterous melanopline grasshopper, *Appalachia hebardii* Rehn and Rehn, is a late season, univoltine species that occurs in the Appalachian ridges of West Virginia, Virginia, and Pennsylvania, U.S.A. Data on this species were taken from a population near Mathias, West Virginia. *A. hebardii* feeds on understory vegetation and prefers older foliage. Both sexes went through five instars to become adults. Body size was within previously published ranges. Mean population ovariole number was 11.44 ± 1.13 (Bellinger and Pienkowski, 1985), and mean pod size was 9.67 ± 2.08 . Maximum pod size is estimated to be 14. Some females can lay at least two pods during the season. Our observations corroborate previous reports and extend the life history information on *A. hebardii*.

Appalachia hebardii Rehn and Rehn is a brachypterous grasshopper from the Appalachian Mountains of West Virginia, Virginia, and Pennsylvania (Rehn and Rehn, 1936, 1939). The genus contains one other species, *A. arcana* Hubbell and Cantrall, known from Michigan (Hubbell and Cantrall, 1938). Little is known of their biology. This paper provides new information, including food plants in the field and laboratory, development, fecundity, and seasonal occurrence of *A. hebardii*. We previously published femur lengths and ovariole numbers for this species (Bellinger and Pienkowski, 1985), but include these data here for completeness.

MATERIALS AND METHODS

Grasshoppers were collected by the senior author (RGB) from the undergrowth around a cabin on the eastern slope of Big Ridge, east of the boundary of Lost River State Park, Mathias, Hardy Co., West Virginia

(Bellinger and Pienkowski, 1985). The elevation of the site is ca. 700 meters. The species had been seen feeding in small numbers on native and cultivated plants during 1981 and 1982, but were less abundant in 1983 (F. E. Wood, Dept. of Entomology, University of Maryland, personal communication). The collection site was characterized by an overstory dominated by chestnut oak, with an understory of black gum (*Nyssa sylvatica* Marsh.), dogwood, and sucker growth of American chestnut (*Castanea dentata* (Marsh.) Borkh.). Undergrowth was predominately mountain laurel (*Kalmia latifolia* L.), and *Vaccinium* spp. Grasshoppers were all on the ground when collected. Collecting was difficult because of the scarcity of individuals and because when disturbed they jumped long distances, even in the dense undergrowth. One immature and one adult male, and one immature and two adult females were collected on 12 September, 1983. One adult male and six adult

females were collected in mid-October, 1983. Individuals from each collection were returned to the laboratory, at Blacksburg, VA. The initial intent of the collections was to identify the species and determine ovariole number in the females. The species was tentatively identified by RGB as *A. hebardii*.

Grasshoppers were maintained at 30°C in a rearing chamber, with 2–3 individuals per 0.45 L paper carton with screened top and bottom. Initially, grasshoppers were provided with fresh romaine lettuce (*Lactuca sativa* L. cv. 'Romana'), ground dry dog food (25% crude protein), and misted with water twice daily. Because the grasshoppers did not noticeably feed on the lettuce, other plants were tried as food, including fescue grass (*Poa pretensis* L.), leaves of dandelion, (*Taraxacum officinale* Weber), Crimson clover (*Trifolium incarnatum* L.), three species of dogwood (*Cornus florida* L. and *C. spp.*), and red, white, and chestnut oak (*Quercus rubra* L., *Q. alba* L., and *Q. prinus* L.). Chestnut oak leaves were brought from the collection site. All other plants were collected near the laboratory.

Grasshoppers from each collection were held for three to four days, or until all individuals had become adults. All individuals were sacrificed at that time. Females were dissected to determine ovariole number (Bellinger and Pienkowski, 1985) and their ovipositional status (Launois-Luong, 1978). Measurements of total body length, hind femur, and tegmen were made on three males and nine females, and of the length and width of the pronotum of the females. Because development of the grasshoppers was not observed in the field or in the laboratory, the number of antennal segments in the adults were counted to determine number of instars required to reach the adult (Shotwell, 1941).

RESULTS

The identification of this species as *Appalachia hebardii* Rehn and Rehn was confirmed by Irving J. Cantrall, Museum of Zo-

ology, University of Michigan, Ann Arbor (retired).

Habitat and food plants.—Feeding previously had been noted on native mountain laurel, sucker growth on cut chestnut oak stumps, several herbaceous weeds, and on cultivated rose of sharon (*Hibiscus* sp.). In the laboratory the grasshoppers ate ground dry dog food but not romaine lettuce. Grasshoppers ate old leaves from lower parts of the three dogwood species but not newer leaves from branch ends. Similarly, only older leaves of dandelion were eaten. Grasshoppers did not feed on foliage from the three species of oak, or the grass, or the clover.

Body size.—Body measurements (mean \pm SD (mm)) were: total body length, males—20.87 \pm 1.16, females—25.27 \pm 2.06, hind femur, males—10.9 \pm 0.35, females—12.28 \pm 0.52, tegmen, males—4.33 \pm 0.57, females—4.59 \pm 0.38, pronotal length, females—5.09 \pm 0.43, pronotal width—4.10 \pm 0.38.

Antennal segments and instar number.—Two of the males had 23 antennal segments, and one had 24 segments. Three of the females had 23 segments, and the remaining six had 24. There was no apparent difference in segment number because of collection dates. Antennal segment counts showed that all individuals in each sex had gone through five developmental stadia to reach the adult. Antennae were long for the number of segments. Individual segments were visibly longer than in the genus *Melanoplus* Stal.

Fecundity.—*Appalachia hebardii* mated readily in the laboratory. No eggs were laid in the laboratory, probably because a suitable ovipositional media was not provided. Mean ovariole number per female was 11.44 \pm 1.13 SD, and ranged from 10 to 13 (Bellinger and Pienkowski, 1985). There were five to seven ovarioles per ovary, so there could be up to 14 ovarioles per female. Dissections of females, collected as adults in the field, showed that the two adults collected in September each had 12 ovarioles.

One showed little development of the ovaries, and the other had laid one pod with 12 eggs but had not yet begun development of a second pod. Adult females collected in October showed a range of ovarian development. One female had oviposited twice and was developing a third pod. This female had 11 ovarioles and had laid eight eggs in the first pod and nine eggs in the second pod. Seven oocytes were being developed, indicating a maximum of seven eggs in the potential third pod. None of the others had oviposited, nor had they begun oocyte development, but two had 12 ovarioles and 12 well developed oocytes each. Average pod size was thus 9.67 ± 2.08 ($n = 3$ pods). While color of the chorion in grasshopper eggs varies among species, developing oocytes of this species were bright yellow, the same color observed in other Melanoplinae, and in most Oedipodinae and Gomphocerinae (unpublished). We did not observe any post-ovipositional eggs. No parasites were noted in any dissection.

DISCUSSION

Observations made on a small population of *A. hebardii* from West Virginia confirm some observations previously made on the species. The collection site was a habitat similar to those described by Rehn and Rehn (1936). The elevation in West Virginia was within the 550 to 1220 m range of elevations given for the species (Rehn and Rehn, 1939). We found as did Rehn and Rehn (1936) that the species jumped long distances to escape capture. Plant associations but no food plants were given by Rehn and Rehn (1936). Our field observations and laboratory feedings, although somewhat limited, suggested that the species feeds on older foliage of undergrowth species.

Individuals from the Mathias, WV population in 1983 went through five stadia. This is a common number of stadia for acridid grasshoppers. Brachypterous acridid grasshoppers frequently go through a reduced number of stadia (four or five), and

as a result have small body sizes (Mason, 1954; Uvarov, 1966, 1977). Species from woodlands and higher altitudes are frequently brachypterous. Body size measurements for the Mathias, WV population fell within the range reported by Rehn and Rehn (1936), except for the length of the tegmen in males, which was longer.

Appalachia hebardii has small ovaries (low number of ovarioles), a condition which is related to its small body size (Bellinger and Pienkowski, 1985). Our counts of ovarioles indicate potential pod sizes of 10 to 14 eggs per pod. Our data showed that pod sizes in the field averaged 9.67 eggs. Rehn (1938) reported "approximately ten eggs" from a single pod. Females in the Mathias population are capable of laying at least two, and possibly three pods per female, based on one female. Thus, this species may lay up to ca. 42 eggs per female, on the basis of these limited data. The oviposition substrate for this species remains unknown. While most acridid grasshoppers oviposit in the soil, some woodland species oviposit in holes in dead wood (Blatchley, 1920).

Rehn and Rehn (1936) reported that *A. hebardii* occurred as early as the first week of July, to as late as early September, over its range. Our collections were made in mid-September, when we collected immatures and adults, and mid-October. The reproductive status of adult females showed that the population began oviposition before mid-September, but that as late as mid-October some females had yet to oviposit, or even begin to develop their first pod. At the elevation of the Mathias site, the growing season is over by mid-October, and unless this species is adapted to cooler temperatures and senescent food plants, some females in the population may never oviposit.

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